

WHAT IS CLAIMED IS:

1. A lithium secondary cell comprising a cell element which comprises a positive electrode, a negative electrode and an electrolyte comprising a non-aqueous solvent and a solute, and a variable shape casing which accommodates the cell element, wherein the cell element contains an additive α , and $\Delta E_{add}(AN)$ is smaller than $\Delta E_{sol}(AN)$, where $\Delta E_{sol}(AN)$ is the difference represented by $E_{sol}(A) - E_{sol}(N)$, where $E_{sol}(N)$ is the enthalpy of a neutral molecule of the non-aqueous solvent and $E_{sol}(A)$ is the enthalpy of an anion radical formed by giving one electron to the neutral molecule, as obtained by the following calculation method (#), and $\Delta E_{add}(AN)$ is the difference represented by $E_{add}(A) - E_{add}(N)$, where $E_{add}(N)$ is the enthalpy of a neutral molecule of the additive α and $E_{add}(A)$ is the enthalpy of an anion radical formed by giving one electron to the neutral molecule, as obtained by the following calculation method (#),

Calculation method (#):

The enthalpy of a neutral molecule and the enthalpy of an anion radical are, respectively, obtained by quantum chemical calculations by an ab initio restricted Hartree-Fock molecular orbital method employing 6-31G* basis function system.

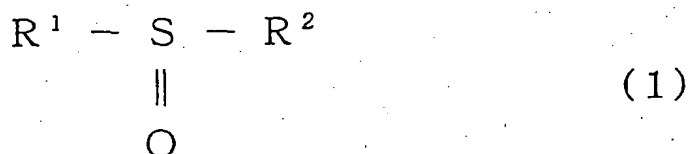
2. The lithium secondary cell according to Claim 1, wherein $\Delta E_{sol}(AN) - \Delta E_{add}(AN)$, i.e. the difference

between $\Delta E_{sol}(AN)$ and $\Delta E_{add}(AN)$, is at least 0.1 eV and at most 4 eV.

3. The lithium secondary cell according to Claim 1, wherein the additive α is a Lewis acid.

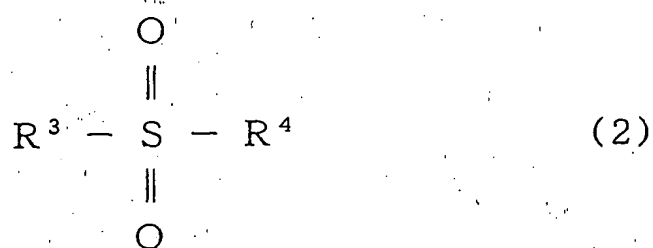
5 4. The lithium secondary cell according to Claim 1, wherein the additive α is a sulfur compound having at least one sulfur-oxygen double bond.

5. The lithium secondary cell according to Claim 4, wherein the sulfur compound is represented by the
10 following formula (1):



(in the above formula (1), each of R^1 and R^2 which are independent of each other, is X^1 or $O-X^1$, where X^1 is a C_{1-9} chain or cyclic saturated hydrocarbon group, a C_{1-9}
15 chain or cyclic unsaturated hydrocarbon group or a C_{6-9} aromatic hydrocarbon group, provided that R^1 and R^2 may be bonded to each other to form a 5- or 6-membered ring containing the sulfur atom).

6. The lithium secondary cell according to Claim 4,
20 wherein the sulfur compound is represented by the following formula (2):



(in the above formula (2), each of R^3 and R^4 which are independent of each other, is X^2 or O-X^2 , where X^2 is a C_{1-9} chain or cyclic saturated hydrocarbon group, a C_{1-9} chain or cyclic unsaturated hydrocarbon group or a C_{6-9} aromatic hydrocarbon group, provided that R^3 and R^4 may be bonded to each other to form a 5- or 6-membered ring containing the sulfur atom).

7. The lithium secondary cell according to Claim 4,
 10 wherein the sulfur compound is at least one member selected from the group consisting of diethyl sulfoxide, diphenyl sulfoxide, tetramethylene sulfoxide, methyl methanesulfinat, ethyl ethanesulfinat, dimethyl sulfite, diethyl sulfite, 1,2-propylene glycol sulfite, 1,3-
 15 butylene glycol sulfite, diphenyl sulfite, ethylene sulfite, vinylene sulfite, dimethyl sulfone, diethyl sulfone, ethylmethyl sulfone, diphenyl sulfone, dibenzyl sulfone, sulfolane, 3-methyl sulfolane, 3-methyl sulfolene, methyl methane sulfonate, ethyl
 20 methanesulfonate, acetyl methanesulfonate, tetrahydrofurfuryl methanesulfonate, methyl ethanesulfonate, ethyl ethanesulfonate, methyl propanesulfonate, methyl benzenesulfonate, 1,3-

propanesultone, 1,4-butanedisultone, dimethyl sulfate, diethyl sulfate, ethylmethyl sulfate, methylphenyl sulfate, ethylene glycol sulfuric acid ester, 1,3-propanediol sulfuric acid ester and 1,4-butanediol sulfuric acid ester.

8. The lithium secondary cell according to Claim 4, wherein the sulfur compound is contained in an electrolyte.

9. The lithium secondary cell according to Claim 4, wherein the sulfur compound is contained in an amount of at least 0.001 part by weight and at most 30 parts by weight, to the total amount of the solute and the non-aqueous solvent.

10. The lithium secondary cell according to Claim 1, wherein the positive electrode contains a lithium-nickel compound oxide.

11. The lithium secondary cell according to Claim 10, wherein the lithium-nickel compound oxide is represented by the following formula (3):



(in the formula (3), a, X, Y and Z are, respectively, numbers which satisfy $0 \leq a \leq 1.1$, $0.5 \leq X \leq 1$, $0 \leq Y \leq 0.5$, $0 \leq Z \leq 0.1$, and $0.9 \leq X+Y+Z \leq 1.1$).

12. The lithium secondary cell according to Claim 10, wherein the specific surface area of the lithium-nickel compound oxide is within a range of from 0.01 to $10 \text{ m}^2/\text{g}$.

13. The lithium secondary cell according to Claim 1,

wherein the positive electrode contains an organic acid and/or a lithium salt of an organic acid.

14. The lithium secondary cell according to Claim 13, wherein the organic acid is a bivalent or higher valent organic acid.

15. The lithium secondary cell according to Claim 13, wherein the lithium salt of an organic acid is a lithium salt of a bivalent or higher valent organic acid.

16. The lithium secondary cell according to Claim 13, wherein the positive electrode has a positive electrode material layer formed on a current collector, and the organic acid and/or the lithium salt of an organic acid is contained in an amount within a range of at least 0.1 wt% and at most 1 wt%, based on the weight obtained by deducting the weight of the organic acid and/or the lithium salt of an organic acid from the total weight of the positive electrode material layer.

17. The lithium secondary cell according to Claim 1, wherein the electrolyte further contains a polymer.

18. The lithium secondary cell according to Claim 17, wherein the polymer is a cross-linkable polymer.

19. The lithium secondary cell according to Claim 18, wherein the cross-linkable polymer is an acrylic polymer.

20. The lithium secondary cell according to Claim 1, wherein the variable shape casing is made of a laminated film comprising a gas barrier layer and a resin layer.